What is claimed is:

[Claim 1] 1. A process for improving the oxidation resistance of a beta-phase nickel aluminide overlay coating (24), the process comprising the steps of:

depositing the beta-phase nickel aluminide overlay coating (24) on a surface (38) of a substrate (22), the overlay coating (24) being deposited so as to be characterized by as-deposited grains (42) with as-deposited grain boundaries (44) that are continuous through the overlay coating (24) from an outer surface (36) of the overlay coating (24) to the surface (38) of the substrate (22), the as-deposited grain boundaries (44) being exposed at the outer surface (36) of the overlay coating (24) and containing precipitates (40); and then

causing the overlay coating (24) to form new grain boundaries (34) that are open to the outer surface (36) of the overlay coating (24) and contain fewer precipitates (40) than the as-deposited grain boundaries (44).

[Claim 2] 2. A process according to claim 1, wherein the new grain boundaries (34) are formed by recrystallizing the overlay coating (24) so that new grains (32) form and the average aspect ratio of the new grains (32) is smaller than the average aspect ratio of the as-deposited grains (42).

[Claim 3] 3. A process according to claim 2, wherein recrystallization of the overlay coating (24) is induced by depositing the overlay coating (24) while the substrate (22) is at a temperature of at least 900°C.

[Claim 4] 4. A process according to claim 2, wherein recrystallization of the overlay coating (24) is induced by peening

the overlay coating (24) and then heating the overlay coating (24) to a temperature above 980°C in a low-oxygen atmosphere.

[Claim 5] 5. A process according to claim 4, wherein some of the precipitates (40) are dissolved during the heating step.

[Claim 6] 6. A process according to claim 1, wherein the precipitates (40) are substantially absent from the new grain boundaries (34).

[Claim 7] 7. A process according to claim 1, wherein the precipitates (40) are zirconium-rich particles.

[Claim 8] 8. A process according to claim 1, wherein the overlay coating (24) contains zirconium.

[Claim 9] 9. A process according to claim 1, further comprising the step of depositing a ceramic coating (26) on the overlay coating (24) to form a thermal barrier coating system (20).

[Claim 10] 10. A process for improving the oxidation resistance of a beta-phase nickel aluminide overlay coating (24), the process comprising the steps of:

depositing the overlay coating (24) on a surface (38) of a superalloy component (10,22) by physical vapor deposition, the overlay coating (24) being deposited so as to be characterized by as-deposited grains (42) defining as-deposited grain boundaries (44) that are continuous through the overlay coating (24) from an outer surface (36) of the overlay coating (24) to the surface (38) of the component (10,22), the as-deposited grain boundaries (44) being exposed at the outer surface (36) of the overlay coating (24) and containing zirconium-containing precipitates (40); and then

peening and heat treating the overlay coating (24) to recrystallize the overlay coating (24) and form new grains (32) that define new grain boundaries (34) that are open to the outer surface (36) of the overlay coating (24) and contain fewer precipitates (40) than the as-deposited grain boundaries (44).

[Claim 11] 11. A process according to claim 10, wherein the new grains (32) have an average aspect ratio that is smaller than the average aspect ratio of the as-deposited grains (42).

[Claim 12] 12. A process according to claim 10, wherein the overlay coating (24) is heat treated at a temperature about 980°C to about 1020°C in a low-oxygen atmosphere.

[Claim 13] 13. A process according to claim 10, wherein some of the precipitates (40) are dissolved during the heat treating step.

[Claim 14] 14. A process according to claim 10, wherein the precipitates (40) are reduced in size during the heat treating step.

[Claim 15] 15. A process according to claim 10, wherein the precipitates (40) are substantially absent from the new grain boundaries (34) open to the outer surface (36) of the overlay coating (24).

[Claim 16] 16. A process according to claim 10, wherein the overlay coating (24) contains zirconium.

[Claim 17] 17. A process according to claim 16, wherein the overlay coating (24) further contains chromium.

[Claim 18] 18. A process according to claim 17, wherein the overlay coating (24) consists of, in atomic percent, about 30% to about 60% aluminum, about 0.1% to about 1.2% zirconium, optionally up to about 15% chromium, and the balance essentially nickel.

[Claim 19] 19. A process according to claim 10, further comprising the step of depositing a ceramic coating (26) on the overlay coating (24) to form a thermal barrier coating system (20).